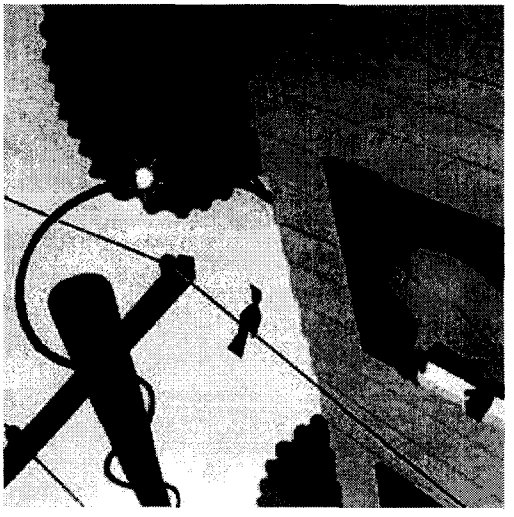
OPINION

SPEAK OUT

Paving the Last Mile With Glass

If U.S. phone companies don't lay fiber, the cable industry will eat their lunch

By Paul E. Green Jr.



To the too-casual observer, the last thing the local telephone companies need to worry about is installing optical fiber in their subscriber loops—the infamous "last mile" connections between their facilities and the subscribers' homes and offices. After all, where are the compelling new applications that require capabilities beyond today's copper-based broadband, slowly emerging in the form of cable modems and digital subscriber lines (DSLs)?

Consider the key facts. Each year, the local phone companies (more properly known as ILECs, for incumbent local exchange carriers) replace 3-4 percent of their copper twisted-pair subscriber lines because of physical deterioration. They also add 1.5 million lines annually to newly built homes. But by largely ignoring the opportunity to use fiber for these installations, they are putting their very survival at risk.

The future does in fact belong to fiber-based high-performance broadband (plus wireless for lower bit rates and shorter distances), and if the telephone companies don't provide it, the cable companies will drive them to the wall.

Tackling the bottleneck

But, given the current lack of compelling applications, how can I be so sure that fiber last-mile connections are inevitable? First of all, because the last mile is an unnatural bottleneck

between the high-speed communications going on within our computers, on the one hand, and the high-speed networks available for interconnecting those computers, on the other. It is the proverbial weak link, and it simply can't persist indefinitely.

Both computers and the common carriers' systems run at multiple tens of gigabits per second. Dial-up modems carry, at best, 50 kb/s—nowhere near enough to support the innovative new services on which the future prosperity of both the telecom and computer industries depends. DSLs and cable modems, both of which run below 1 Mb/s downstream (to the subscriber) and considerably less than that upstream when fully subscribed, are a step in the right direction, but not much more. Today's broadband languishes with not enough compelling applications and too few users because of inadequate data rates.

To get back on the road to prosperity, the communications and computer industries must offer such services as video on demand, music on demand, videoconferencing, distance learning, interactive game playing, multimedia Web searches, and the like—to say nothing of unforeseen new services enabled by data rates measured in the gigabits per second, and all with snappy responsiveness.

Interesting, you may say, but why the urgency? Not only because fiber to the home is already happening, but especially because the cable giants are gearing up to do battle for the minds, hearts, and one-stop voice, video, and data-access business of residential and small business customers. And these tough competitors are likely to be a much more serious threat to the large ILECs than anything they have previously encountered.

In their aggressive long-range game, cable companies are wiring as many homes as possible, first with TV and then with cable-modem service. Then they can easily add telephone service, connecting to the public-switched telephone network via the ILECs' central offices. Before long, thanks to the high bandwidth of coaxial cable, they will also begin pushing high-definition television on the shorter links, strengthening their position as the home portal of choice. It's hard to see how the ILECs will be able to match these offerings with their copper twisted pairs.

The reasons for fiber

There are a number of other reasons for preferring fiber access over copper. First of all, the lifetime costs of the all-glass solution are less than those of any copper-based solution, since the others include hot, costly finite-lifetime electronics with backup power sources distributed throughout the service area. Second, glass is transparent with respect to legacy or future bit rates and formats—in other words, as more advanced broadband formats and systems become available, the fiber need not be replaced. Third, fiber's low attenuation translates not only into lower-power transmitters and less sensitive receivers, but also into much more convenient design rules for their installation. With DSL or cable, constraints on segment lengths, cable types, variable attenuator settings, and so on are much tighter and add to complexity and cost.

Fourth, fiber is largely unencumbered by the many inherited regulatory restrictions that apply to copper, especially the countless twisted pairs of 24-gauge wire that constitute the crown jewels of the ILECs. A new turn of the crank that allows all players to innovate with this new medium without carrying along all the historical regulatory baggage would relieve the carriers of their traditional dependence on expensive armies of lawyers and lobbyists as the price of business survival. This will be particularly so with respect to the relatively less-regulated cable industry.

Fifth, the passive nature of fiber—and the fact that the electronics is only at the ends—means that provisioning and reprovisioning are accomplished much more quickly than with systems embodying electronics along the right of way.

Passivity is powerful

Fiber is already being deployed in the last mile. A number of start-ups are installing so-called passive optical networks (PONs), mainly in new "green-field" housing developments, independent rural co-ops, and other markets apparently considered peripheral by the large incumbent local carriers. PONs are tree-like networks in which one fiber leaving the central office reaches up to, say, 32 residences by passively splitting the light by a factor of four, and then splitting each of these lines again by a factor of eight as they branch out to individual homes. With this setup, PONs make it easy to provide one-stop shopping for an attractive triple play of services: voice phone lines, Ethernet, and video—either analog or digital.

But the availability of fiber in the last mile is likely to remain limited to small geographical regions until one or more ILECs commit to a massive replacement or augmentation of existing copper pairs with fiber, most likely in PON form. Many industry observers expect this to happen within three to five years.

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For the next several years, the total number of fiber-to-the-home installations in the United States—which stood at about 22 500 as of July 2002, according to real "census" data from Renner Vanderslice and Associates (Tulsa, Okla.)—will remain minuscule compared with the number of DSLs (3.4 million) and cable modems (7.2 million).

This situation does not seem to alarm the incumbent carriers. They appear to be in a holding pattern, waiting for a slackening of regulatory oversight or for the cable companies to actually win away significant numbers of voice and broadband customers before doing anything about it. To me, it would seem a lot smarter to leverage fiber-based PONs to leapfrog the cable companies' copper-based forays into their voice-based present and broadband-based future.

Perhaps the highly visible losing battle of DSL against cable modems will prod them into action. Nationwide, cable modems have been winning consistently by a factor of between 2:1 and 3:1. And the true picture may be even bleaker than those numbers suggest. DSL seems to have made its greatest inroads so far among customers closest to the ILECs' facilities—that is, the ones that are relatively easy and cheap to connect. Therefore, sustaining even this inferior rate of penetration will prove increasingly difficult.

Cost is everything

Meanwhile, the cost trend in fiber to the home is going in the right direction. The lifetime cost of a fiber hookup is already less than that of copper, but it does require a larger up-front expenditure. Much of this outlay goes for opto-electronic terminal equipment, so further penetration will depend on declines in prices for optical components. Fortunately, that's what's happening: for example, passive power splitters, which cost over US $100 per port a year ago, now go for $25 per port.

Equally favorable trends are evident in fiber-installation technology. Machines can now cut narrow grooves rapidly in the pavement along city streets to lay in small fiber bundles. Small trenching machines install plastic ducts 30-60 cm underground, and remotely controlled directional drilling robots extend the path of the duct under driveways, highways, and in one case, for 2 km under the Hudson River. Often, if these ducts do not already contain the fiber, it can be later blown in by compressed air, allowing for upgrades and rehabs without further

excavation. It is even possible now to send a lineman up a utility pole to perform single or multiple splices, a process that was thinkable only in the laboratory not many years ago.

On average, the per-residence cost of a PON installation is estimated at $2000 to $2500. That is low enough for providers to create positive business cases for offering complete triple-play services for as little as $70 to $100 per month with a payback period of less than three to four years.

The future seems clear. The only questions are: how far off is it, and to whom will it belong?

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URL: http://www.spectrum.ieee.org (Modified: 29 November 2002)

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